NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATON

NUTRIENT MANAGEMENT

(Acre)
CODE 590

GENERAL

Nutrient values for various animal manures and organic by-products can be determined by laboratory tests as described in the Waste Utilization Standard 633 or from Table 1 below. Liquid wastes will be laboratory analyzed and the test values used in place of table values. It is difficult to sample solid stack manure. Table 1 values can be used in place of laboratory test for solids.

NUTRIENT VALUES

Table 1 Approximate Nutrient of Various Types of Animal Manure at the time of Land Application*

Type of Nutrient		Total Content (lbs/ton)			
Solid Handling System	**Moisture Content (%)**	**TKN**	**NH_4-N[a]**	**P_2O_5**	**K_2O**
Swine	82	10	6	9	8
Beef	32	23	7	24	41
Dairy Cattle	46	13	5	16	34
Sheep	31	29	5	26	38
Chickens-w/o litter	55	33	26	45	34
Chickens-w/litter	25	56	36	45	34
Turkeys-w/o litter	78	27	17	20	17
Turkeys-w/litter	71	20	13	16	13
Horses-w/o bedding	22	19	4	14	36

Type of Nutrient		TKN		NH_4-N[a]		P_2O_5		K_2O	
Liquid Handling Systems	**Moisture Content (%)**	**lbs/ acin**	**lbs/ 1000 gal**	**lbs/ acin**	**lbs/ 1000 gal**	**lbs/ acin**	**lbs/ 1000 gal**	**lbs/ acin**	**lbs/ 1000 gal**
Swine-liquid pit	96	977	36	706	26	733	27	599	22
Swine-single anaerobic	99	190	7	163	6	54	2	190	7
Swine-two stage anaerobic	99	109	4	81	3	54	2	190	7
Beef-lagoon[b]	99	109	4	54	2	244	9	135	5
Dairy Cattle-lagoon	99	109	4	54	2	109	4	272	10
Dairy Cattle-liquid pit (solids and liquid)	92	651	24	325	12	488	18	787	29
Poultry-liquid pit	87	2172	80	1733	64	977	36	2606	96

[a]Ammonia fraction can vary significantly across time and systems. Numbers given are for planning purposes only; liquid manure will be tested for nutrient content before field application.

[b]Includes runoff water.

* These values are derived form the USDA Agriculture Waste Management Field Handbook, 1992, and are modified with data from Colorado and New Mexico feeding operations when possible. Nutrient compositions of manure vary with the age, breed, feed ration, and manure handling.

VOLATILIZATION

Table 2 lists the Volatilization losses of manure or organic byproduct. This table shows the loss of the Ammonia (NH3) part of the Total N (See Table 1) at the time of spreading.

Table 2 *Approximate percentage of Ammonia (N-NH_4) remaining after application to the soil.

Application Method	Percent remaining after application					
	Warm Dry Soil		Warm Wet Soil		Cool Wet Soil	
	Range	Use	Range	Use	Range	Use
Injection	100-97	**97**	100-97	**97**	100-97	**97**
Sprinkler w/o incorporation	35-75	**35**	35-75	**55**	35-75	**75**
Surface Irrigation w/o incorporation & **w/o** crop canopy	60-90	**60**	60-90	**75**	60-90	**90**
Surface Irrigation w/o incorporation & **w/**crop canopy	80-95	**80**	80-95	**88**	80-95	**95**
Broadcast-incorporated in **1 day**	-	**70**	-	**90**	-	**100**
Broadcast-incorporated in **4 days**	-	**60**	-	**80**	-	**95**
Broadcast-incorporated in **7 days**	-	**50**	-	**70**	-	**90**

*(Adapted from Table 11-6 in the AWMFH and Colorado State Bulletin 568A “Best Management Practices for Manure Utilization”)

MINERALIZATION

Table 3 shows the mineralization percentage of organic N, P, and K of various manure sources for a one-year application.

Table 3 * Mineralization **percentage of organic N, P, and K of various manure sources for a one year application**

Manure Source	Percentage of Available Nutrients w/One Year's Application								
	Organic Nitrogen (N)			Phosphorus (P)			Potassium (K)		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Beef and Dairy Cattle Solid w/o bedding	35	13	8	75	10	5	80	8	5
Beef and Dairy Cattle Liquid (anaerobic)	30	8	5	75	10	5	80	8	5
Swine solid	50	6	5	75	10	5	80	8	5
Swine liquid (anaerobic)	40	7	5	75	10	5	80	8	5
Sheep solid	25	8	5	75	10	5	80	8	5
Horse solid w/bedding	20	8	5	75	10	5	80	8	5
Poultry solid w/o litter	35	13	8	80	8	5	85	8	5

*Table assumes one time application. Adapted from Table 11-9 in the AWMFH and Colorado State Bulletin 568A "Best Management Practices for Manure Utilization".

DENITRIFICATION

Animal manures and organic by-products can lose N (N2)to denitrification. Table 4 is used to estimate this loss using the percent organic matter in the soil and the soil survey drainage classification.

Table 4 *N denitrification estimates for various soils from (Meisinger and Randall 1991)

Soil Organic Matter Content (%)	Percent of Manure N Denitrified									
	Excessively Well Drained		Well Drained		Moderately Well Drained		Somewhat Poorly Drained		Poorly Drained	
	Range	Use	Range	Use	Range	Use	Range	Use	Range	Use
<2	4-8	6	6-18	12	8-28	18	12-40	26	20-60	40
2-5	6-18	12	8-32	20	12-40	26	20-50	35	30-90	60
>5	8-24	16	12-40	26	20-50	35	30-70	50	50-100	80

*From Table 11-8 in the AWMFH 4/92.

NITROGEN CREDITS

There are nitrogen credits that should be added to the nutrient budget. The important ones for NM are: N in the irrigation water, OM N (added automatically when the NMSU Fertilizer Interpretation Software is used), and additions from a previous legume crop (NOT soil incorporated 2 months prior to the soil test). Table 5 shows the values to use for these credits.

Table 5 *Nitrogen Credits

Nitrogen Source[a]	Nitrogen Credit
Soil Organic Matter (auto calculated by software)	30 lbs/ac for each 1 percent OM
Residual Soil Nitrate (auto calculated by software)	3.6 lbs/ac for each ppm NO_3-N (1 ft sample)
Irrigation Water (needs to added)	1 ppm in the Irrigation Water = 2.7 lbs N per Ac Ft of water applied (2.7x ppm NO_3-N = lbs NO_3-N/Ac)
Previous Crop, Alfalfa >80% stand (not plowed out)	100-140 lbs/ac N, **Use** 100 lbs/ac
Previous Crop, Alfalfa 60-80% stand (not plowed out)	60-100 lbs/ac N, **Use** 60 lbs/ac
Previous Crop, Alfalfa <60% stand (not plowed out)	30-60 lbs/ac N, **Use** 45 lbs/ac
Other Legume Crop (not plowed out)	30 lbs/ac N

***From Colorado State Bulletin 568A "Best Management Practices for Manure Utilization".

[a]N sources not added by the software need to be added in the other N sources cell.

NUTRIENTS AVAIBLE FROM MANURE APPLICATION EXAMBLE

A dairy in the Pecos Valley will apply 20 ton/ac of solid manure to a field with less than 60% stand of alfalfa. The field will be soil sampled and plowed out in spring. The manure is 46% water, and will be incorporated in 7 days on warm dry well drained soils with <2 OM. The dairy will apply about 2 acft of irrigation water at about 2 ppm NO3-N in the irrigation water.

Step 1: Calculate the available N, P, & K in the manure

N content of manure	= 13 lbs total N/ton including 5 lbs/ton NH4-N (form Table 1)
Available N	Ammonia N available = 5 lbs/ton NH4-N/ton X 0.50 (volatile loss from Table 2) = 2.5 lbs/ton
	Organic N available = (13 lbs total N/ton – 5 lbs/ton NH4-N) = 8 lbs/ton organic N
	8 lbs/ton organic N X 0.35 (mineralized % from Table 3) = 2.8 lbs/ton
	Denitrification = (2.5 lbs/ton NH4-N + 2.8 lbs/ton organic N) = 5.3 lbs/ton N
	5.3 lbs/ton N X (1-0.12) (well drained < 2% OM from Table 4) = 4.66 lbs/ton N
	4.66 lbs/ton N X 20 ton/ac = 93 lbs/ac net useable N applied
Available P2O5	Mineralization =16 lbs/ton P2O5 (from Table 1) X 0.75 (from Table 3) = 12 lbs/ton P2O5.
	12 lbs/ton P2O5 X 20 ton/ac manure applied = 240 lbs/ac P2O5.

Available K2O	Mineralization = 34 lbs/ton K2O (from Table 1) X 0.80 (from Table 3) = 27.2 lbs/ton K2O.
	27.2 lbs/ton K2O X 20 ton/ac manure applied = 544 lbs/ac K2O
Other N Credits	Irrigation Water Credit– 2 acft/ac X 2.7 lbs N/acft (Table 5) X 2 ppm NO3= 11 lbs/ac NO3-N/ac
	Alfalfa Credit – 45 lbs/ac will be added for the standing alfalfa to be plowed out.
Summary	(93 lbs/ac + 11 lbs/ac + 45 lbs/ac) = 149 lbs/ac N
	240 lbs/ac P2O5, and
	544 lbs/ac K2O
	will be applied with 20 ton/ac manure application. These are the values to be transferred to the nutrient management budget (can computed using NMSU Fertilizer Interpretation Software).

ESTIMATED CROP NUTRIENT REMOVAL RATES

The following table (Table 6) shows the amount of crop nutrients removed by the harvested portion of the crops listed. The estimates are from the average values from several sources compiled by H. Krauss in February 1977 and updated with values from the AWMFH table 6-6 (4/92).

Table 6 Approximate Amount of Plant Nutrients Removed with Harvest

Crop	Unit	Pounds per Unit (lbs/unit)				
		N	P	P_2O_5	K	K_2O
Alfalfa, hay	ton	47.75	4.5387	10.40	36.48	43.94
Apples (42 lbs/box)	box	0.04	0.009	0.021	0.07	.084
Barley, straw	ton	12.13	1.3965	3.20	20.48	24.67
Barley. Grain	ton	39.61	7.1572	16.40	11.45	13.79
Beans, dry	cwt	3.80	0.5237	1.20	0.18	0.22
Beans, dry (vines)	ton	60.00	5.7170	13.10	33.20	39.99
Beans, snap	ton	17.50	5.2021	11.92	15.94	19.20
Beets, sugar, roots	ton	4.02	0.5281	1.21	4.78	5.76
Beets, sugar, tops	ton	8.05	0.7855	1.80	40.55	48.85
Beets, table	ton	6.80	0.5281	1.21	6.97	8.40
Bluegrass, hay	ton	28.73	3.6790	8.43	22.19	26.73
Broccoli	lbs	.0025	0.0004	0.000916	.0045	.0054
Bromegrass, hay	ton	29.00	1.7588	4.03	22.16	26.69
Cabbage	lbs	.0033	0.0004	0.000916	.0027	.00324
Carrots, root	lbs	.0019	0.0004	0.000916	.0025	.003
Celery, tops	ton	3.40	0.7506	1.72	7.55	9.09
Chile, Green	ton	8.0	2.4003	5.50	9.8	11.8
Chile, Red	lbs	.002	0.0012	0.00275	.002	.0024
Clover, Alsike, hay	ton	42.00	4.4078	10.10	20.75	25.00
Clover, Ladino, hay	ton	69.00	5.2806	12.10	40.67	48.99
Clover, red, hay	ton	42.50	4.6260	10.60	31.87	38.39
Clover, sweet, hay	ton	50.00	4.4078	10.10	19.92	24.00
Corn, grain	bu	0.88	0.1602	0.37	0.18	0.22

Table 6 Approximate Amount of Plant Nutrients Removed with Harvest-Cont.

Crop	Unit	Pounds per Unit (lbs/unit)				
		N	P	P_2O_5	K	K_2O
Corn, silage	ton	7.40	5.0188	11.50	5.95	7.17
Corn, stover	ton	17.83	3.5000	8.02	23.78	28.65
Corn, sweet	ton	17.8	4.8	11.0	11.6	13.9-
Cotton, all	bale	13.35	2.9	6.64	4.15	5.0
Cucumber	ton	4.00	1.3965	3.20	5.48	6.60
Fescue, tall, hay	ton	38.60	4.0150	9.20	43.91	52.89
Grapes	ton	5.50	2.0	4.58	8.3	5.56
Grass, hay	ton	28.00	3.6091	8.27	25.90	31.20
Hay, (all)	ton	47.20	4.4951	10.30	37.52	45.20
Ladino clover, seed	cwt	3.0	0.66	1.51	1.16	1.4
Ladino clover, straw	ton	52.0	3.52	8.07	28.22	33.99
Lentils	ton	76.00	7.6591	17.55	15.77	19.00
Lettuce	lbs	.0023	0.0008	0.00182	.0046	.00552
Oat, hay	ton	32.0	5.5861	12.80	18.8	22.56
Oats, grain	bu	0.60	0.1100	0.252	0.15	0.18
Oats, straw	ton	12.03	1.8504	4.24	24.07	28.99
Onions	CWT	0.27	0.0598	0.137	0.19	0.23
Orchardgrass, hay	ton	19.40	9.2389	21.17	18.92	22.79
Pasture (grass, legumes)	ton	63.00	6.6335	15.20	43.16	51.99
Peaches	bu	0.06	0.009	0.021	0.09	0.108
Peanut	bu	1.08	0.051	0.117	.15	.18
Peas, seed	lbs	0.038	.0018	.00413	0.0093	0.0112
Peas, vine	ton	49.00	4.4078	10.10	19.92	24.00
Pecans, shell & nut	lbs	0.03	.0013	.003	0.02	0.24
Potatoes, russet	ton	6.20	3.6004	8.25	8.80	10.60
Potatoes, sweet	ton	6.0	1.2	2.75	8.4	10.08
Red clover, seed	cwt	3.0	0.66	1.51	1.16	1.4
Red clover, straw	ton	31.0	3.1	7.1	22.41	27.0
Reed canarygrass, hay	ton	24.10	4.4121	10.11	37.18	44.79
Rye, grain	bu	1.15	0.1458	0.334	0.26	0.31
Rye, hay	ton	20.00	3.5219	8.07	20.75	25.00
Sorghum, forage	ton	20.75	3.7968	8.70	28.10	33.85
Sorghum, grain	lbs	0.0278	0.006	0.01374	0.007	0.0084
Sorghum, silage	ton	7.35	1.0998	2.52	7.64	9.20
Soybeans	bu	3.43	0.3579	0.82	0.97	1.17
Sweet clover, seed	cwt	3.0	0.66	1.51	1.16	1.4
Sweet clover, straw	ton	25.00	2.2	5.04	16.6	20.0
Timothy, hay	ton	22.00	3.0593	7.01	23.61	28.44
Tomatoes, fruit	ton	4.80	0.9514	2.18	6.31	7.60
Tomatoes, vine	ton	40.00	4.0019	9.17	65.98	79.48
Triticale, hay	ton	40.0	5.5861	12.80	30.0	36.0
Vetch, hairy, hay	ton	56.00	6.5986	15.12	38.18	45.99
Watermelon	lbs	.003	0.0004	0.000916	0.003	0.00036
Wheat, grain	bu	1.16	0.3718	0.85	0.35	0.42
Wheat, straw	ton	10.05	1.2307	2.82	11.16	13.44
Winter pea, Austrian, hay	ton	63.00	4.3991	10.08	29.05	34.99

WASTE WATER USAGE

Table 7 Amount of water used in dairy system.

Waste Water Usage in New Mexico*		
Type of Wash System	**Range (gal/cow/day)**	**Use (gal/cow/day)**
Alley Flush	100	100
Barn Sprinkler (pen washing)	40-50	50
Hand Wash	10-12	12

*From NRCS NM Field Staff judgement and experience.

SOLID AND LIQUID SEPERATION

The following table gives the values to use in NM for determining the amount of solids to store with the liquid fraction of the waste. This would be the part of the waste to calculate into the pond or lagoon.

Table 8 Solid and Liquid Separation

Percent of Solid Waste Stored with the Liquid*		
Type of System	**W/Separator**	**W/O Separator**
Alley Flush System	40%	60%
Hand Wash System	5%	10%
Holding Pen Wash System	10%	15%

*From NRCS NM Field Staff judgement and experience.

The following components shall be included in the nutrient management practice specification:

- Field(s) identification (name or number) and acres,
- aerial photograph or map and a soil map of the site,
- current and/or planned plant production sequence or crop rotation,
- results of soil, plant, water, manure or other organic by-product sample analyses,
- realistic yield goals for the crops in the rotation,
- quantification of all nutrient sources,
- recommended nutrient rates, timing, form, and method of application and incorporation,
- location of designated sensitive areas or resources and the associated, nutrient management restriction,
- guidance for implementation, operation, maintenance, record keeping, and
- complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

If increases in soil phosphorus levels are expected, the specification shall document:

- the Phosphorus Index Rating (NM PI) at which it may be desirable to convert from a nitrogen base to phosphorus based implementation, (see the NM PI),
- the relationship between soil phosphorus levels and potential for phosphorus transport from the field, (see the NM PI), and
- the potential for soil phosphorus draw-down from the production and harvesting of crops.

OPERATION AND MAINTENANCE

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. **Operation and maintenance will address the following:**

- periodic specification review to determine if adjustments or modifications to the practice are needed. As a minimum, the specification will be reviewed and revised with each soil test cycle.

- protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage.
- calibration of application equipment to ensure uniform distribution of material at planned rates.
- documentation of the actual rate at which nutrients were applied. When the actual rates used differ from or exceed the recommended and planned rates, records will indicate the reasons for the differences.

Maintaining records to document practice implementation. As applicable, records include:

- soil test results and recommendations for nutrient application,
- quantities, analyses and sources of nutrients applied,
- dates and method of nutrient applications,
- crops planted, planting and harvest dates, yields, and crop residues removed,
- results of water, plant, and organic by-product analyses, and
- dates of review and person performing the review, and recommendations that resulted from the review.

Records should be maintained for five years; or for a period longer than five years if required by other Federal, state, or local ordinances, or program or contract requirements.

Workers should be protected from and avoid unnecessary contact with chemical fertilizers and organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.

The disposal of material generated by the cleaning nutrient application equipment should be accomplished properly. Excess material should be collected and stored or field applied in an appropriate manner. Excess material should not be applied on areas of high potential risk for runoff and leaching.

The disposal or recycling of nutrient containers should be done according to state and local guidelines or regulations.